Exploring the relationship between high level anomia, attention and cognitive processing deficits: a retrospective data analysis

INTRODUCTION

Since stroke survivors with high level anomia often score within normal limits on traditional assessments of language function, people with mild anomia are often underdiagnosed and underserved. Given the lack of diagnostic specificity and sensitivity for this population, the underlying cause of these deficits may be cognitive rather than linguistic (Moore, 2003). In the last two decades, a growing literature has emerged on cognitive approaches to aphasia and anomia. About 65 percent of stroke survivors exhibit impairments in cognitive processing (Donovan, Kendall, Heaton, Kwon, Velozo and Duncan, 2008), and executive function deficits are particularly noted in people with aphasia (Fridriksson, Nettles, Davis, Morrow and Montgomery, 2006; Helm-Estabrooks, 2002). Alexander (2005) noted the increasing inadequacy of the "standard terminology of aphasia" as recovery progresses, and suggested using the "vocabulary of executive function" to describe residual deficits more appropriately.

The present study is a retrospective data analysis which examines mild anomia from a cognitive neuropsychological perspective, focusing specifically on selective attention and automatic vs. controlled processing. To examine these distinct yet related cognitive functions and their roles in anomia, the following research questions were posed:

1. Do individuals with mild language deficits have impaired performance on tests of selective attention relative to neurologically typical controls?

2. Do individuals with mild language deficits have impaired performance on tasks which require automatic vs. controlled processing relative to neurologically typical controls?

METHODS

Participants

Participants included fourteen individuals who had experienced a left hemisphere stroke and self-reported mild anomia, and twelve neurologically typical, age- and education-matched controls. Inclusion criteria included native English-speakers, right-handed, with a Western Aphasia Battery AQ $\geq$ 90/100 and Boston Naming Test score of $\geq$ 50/60. Participants with anomia were at least six-months post onset of a single left hemisphere stroke. Exclusion criteria included a history learning disability, developmental language delay or attention deficit disorder, or evidence of diffuse brain injury or disease. Additionally, all participants completed a standard screen, which included the Wechsler Memory Scale (III) and Adult Intelligence Scale (III), Brief Visual Memory Test, Rey-Osterrieth Complex Figure Copy, Ravens Progressive Matrices, and the Self-Rating Depression Scale.

Instrument and procedure

Participants completed two forms of the Covert Orienting of Visuospatial Attention Task (COVAT and COVAT+Read; Posner and Cohen, 1980). For both forms of the COVAT, participants sat in front of a computer, where two horizontally centered boxes appeared on the monitor. They were instructed to focus on a fixation cross between the boxes and press a button (hand unspecified) as soon as a target (large asterisk) appeared in one of the boxes. The target was presented in one of three conditions: *cued/valid* (target follows a prompt; i.e., brief highlight (wider, brighter) of the box's border), *uncued* (target appears with no box highlighted) and *invalid* (target appears in the box opposite the one highlighted) conditions. Targets appeared equally within two interstimulus (cue to target) intervals (ISI): 100 and 800 msec. The 100 msec ISI is thought to assess automatic processing, while the 800 msec ISI is thought to assess controlled processing (Hagoort, 1993; Petry, Crosson, Gonzalez Rothi, Bauer and Schauer, 1994).

The COVAT+Read task introduced a language interference component to test selective attention. In this task, participants were instructed to focus on the fixation cross between boxes, and read aloud a word which appeared in its place while continuing with the primary COVAT task. The one- and two-syllable, high-frequency, English words appeared 100 msec after trial initiation (and before a cue, if present).

In total, the experimental task consisted of five blocks of 48 trials each (i.e., 240 trials), with one-minute rest between each block.

RESULTS

To answer Research Question 1 – *Is there a significant between-group difference on tasks of selective attention?* – a two-by-two repeated measures ANOVA was used to examine group differences on COVAT type (COVAT, COVAT+Read) by participant group (anomic, typical control) in the 800 msec ISI condition. The results showed no significant difference between groups on COVAT alone ($F(1, 24) = .952$, n.s.); however, significant between-group differences were found on COVAT+Read ($F(1, 24) = 5.336$, $p < .05$) with the anomia group significantly slower than typical controls. In other words, the anomia group's performance was similar to controls during the COVAT task alone, but slowed significantly when the task was performed with linguistic interference. ***See Table 1 and Figure 1.***

To answer Research Question 2 – *Is there a significant between-group difference on tasks which require automatic vs. controlled processing?* – a two-by–two (COVAT type x ISI x group) repeated measures ANOVA was used. No significant difference was seen between groups in either ISI condition (100: $F(1,24)=.972$, n.s.; 800: $f(1,24)=2.778$, n.s.). Therefore, participants showed no difference from their typical counterparts on automatic vs. controlled processing when performing the COVAT task alone. ***See Table 2 and Figure 2.*** However, the 100 msec ISI during COVAT+Read also shows a significant between-group difference, $F(1,24) = 14.547$, $p < .005$, indicating a potential deficit in automatic processing in the presence of linguistic interference. ***See Table 3 and Figure 3.***

DISCUSSION

When comparing the COVAT and COVAT+Read tasks at 800 msec, participants with mild anomia were significantly slower when linguistic interference was present. These results, similar to Murray, Holland and Beeson (1997), Murray (2002), and aligning with McNeil, Odell and Tseng (1991), provide evidence that individuals with anomia have difficulty attending to priority stimuli in the presence of linguistic distraction, i.e. they demonstrate impaired selective attention. Specifically, these individuals may not be able to appropriately suppress non-priority stimuli, even when the primary task is non-linguistic. These findings support the need for diagnostic protocols which include a detailed assessment of attention for people reporting mild anomia to more fully understand the impairment.

Regarding automatic vs. controlled processing, participants with anomia show no difference from typical participants when examining automatic vs. controlled processing on the COVAT task in isolation. Post-hoc analysis, however, revealed a significant difference between these groups when linguistic interference was introduced. The participants with anomia were significantly slower than typical controls at the 100 msec ISI on COVAT+Read. In other words, participants with anomia showed notably slower reaction times compared to typical controls during automatic processing on the task with linguistic interference, indicating possible deficits in automatic processing when linguistic processing is required. Consistent with previous research (Copland, Chenery and Murdoch, 2001; Petry, Crosson, Gonzalez Rothi, Bauer and Schauer,1994), individuals with anomia may not be able to inhibit items activated through the automatic processing mechanism of spreading activation. If inhibition during automatic processing is impaired, lexical selection during discourse may be difficult. It is also possible that automatic processing is slowed overall when processing resources are allocated for multiple tasks, one of which is linguistic.

Conclusion

This study provides evidence that deficits in selective attention may be a source of impairment for people experiencing mild anomia. Additionally, while automatic and controlled processing appears to be intact during task performance in isolation, automatic processing may also be impaired in the presence of a linguistic distraction. Given these results, it follows that assessment and treatment for mild anomia should consider these deficits as a likely component of the impairment. Furthering this line of research will ultimately improve service provision for those with mild anomia.

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APPENDIX

	Anomia Group	Control Group
COVAT at 800 msec	515.49	476.18
COVAT+Read at 800 msec	654.61	497.75

Table 1. *Group mean reaction times (msec) at 800 msec by COVAT type.*

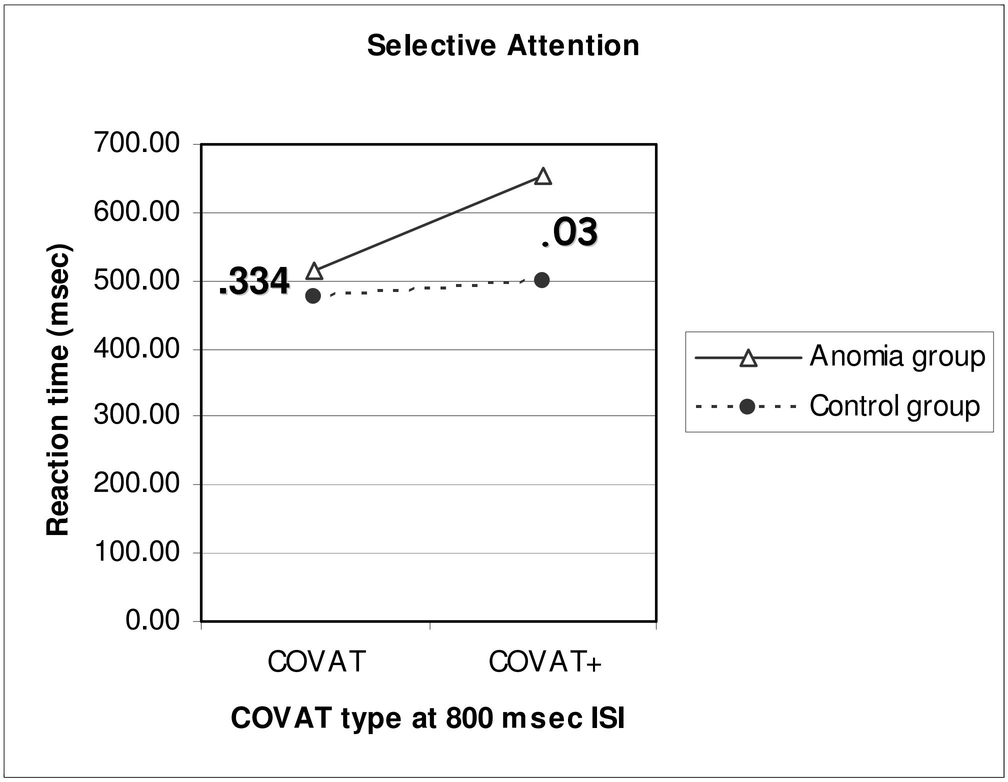

Figure 1. *Group mean reaction times (msec) by COVAT type at 800 msec.*

	Anomia Group	Control Group
COVAT at 100 msec	592.41	507.59
COVAT at 800 msec	515.49	476.18

Table 2. *Group mean reaction times (msec) at 100 and 800 msec for COVAT alone.*

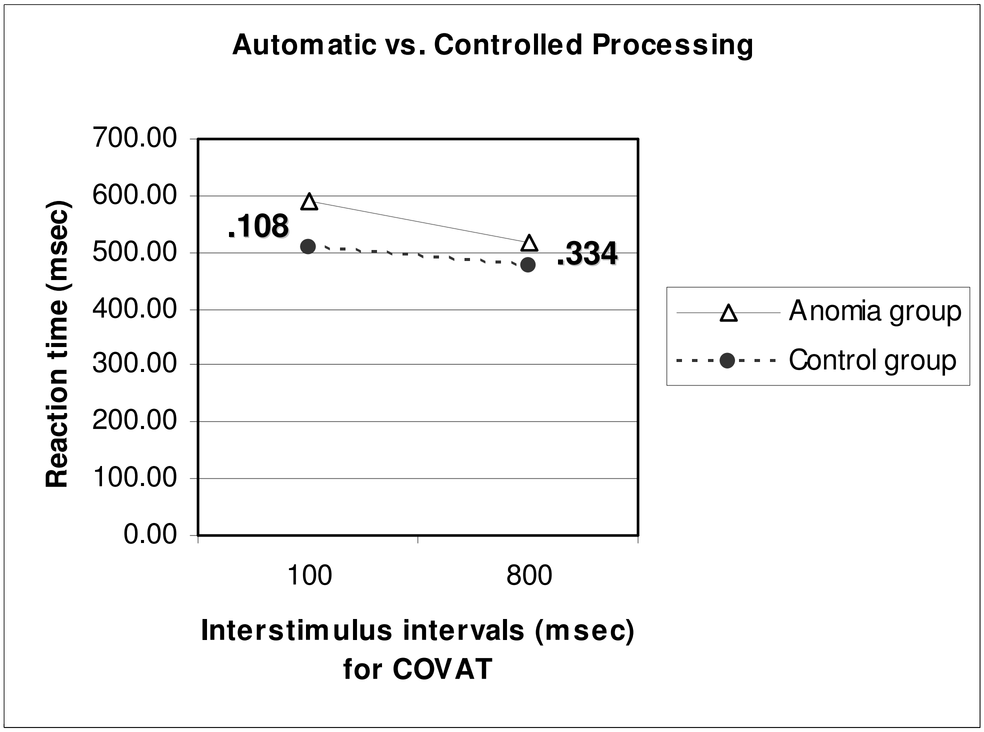

Figure 2. *Group mean reaction times (msec) by ISI for COVAT alone.*

	Anomia Group	Control Group
COVAT+Read at 100 msec	943.70	603.26
COVAT+Read at 800 msec	654.61	497.75

Table 3. *Mean reaction times (msec) for each group at 100 and 800 msec for COVAT+Read.*

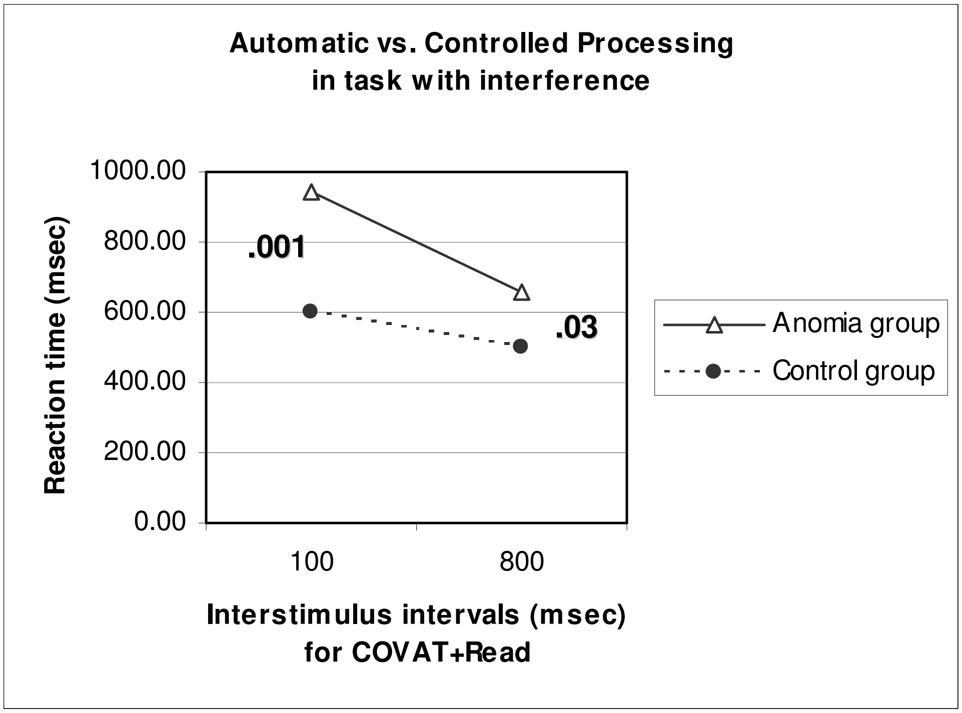

Figure 3. *Group mean reaction times (msec) by ISI for COVAT+Read.*